

AMENDMENT TO CLAIMS

Please amend the claims as set forth herein.

91
1. (Currently Amended) In a FIB ~~system column-subassembly~~ including a ~~system vacuum chamber~~, an ion gun including a liquid metal ion source, a plurality of lens elements for extracting and focusing the ions, one or more beam apertures, and an electrostatic deflection means, the improvement comprising one or more dielectric bushings for positioning one or more lens elements and for providing a sealable vacuum container for the one or more elements, the interior of the vacuum container being vacuum selectively isolatable from the environment in the system vacuum chamber.

2. (Currently Amended) The FIB ~~system column~~ of claim 1 in which the dielectric bushing positions and electrically isolates one or more components of an ion gun and in which the dielectric bushing forms a vacuum container for the ion gun.

3. (Currently Amended) The FIB ~~system column~~ of claim 1 in which electrical wires penetrate at least one of the one or more ~~ceramic-dielectric~~ bushings.

4. (Currently Amended) The FIB ~~system column~~ of claim 3 in which the wires penetrating ~~the~~ at least one or more ~~ceramic-dielectric~~ bushings are vacuum sealed using a fusing process, a brazing process, a glue, or O-rings.

5. (Currently Amended) The FIB ~~system column~~ of claim 1 in which the FIB column includes a final lenses-lens and in which the position of the emitter is fixed relative to the final lenses-lens and further comprising electrostatic steering electrodes between the gun and final lenses.

6. (Currently Amended) The FIB system column of claim 1 further comprising electroetched, electroformed, or laser ablated beam apertures.

7. (Currently Amended) The FIB system column of claim 1 further comprising an in-vacuum isolation valve mechanism.

8. (Currently Amended) The FIB system column of claim 7 in which the in-vacuum isolation valve includes a pneumatic bellows to activate the valve.

9. (Currently Amended) The FIB system column of claim 7 in which the in-vacuum isolation valve includes a pushrod and bell crank to activate the valve.

10. (Currently Amended) The FIB system column of claim 1 further comprising an in-vacuum aperture changing mechanism.

11. (Currently Amended) The FIB system column of claim 10 in which the in-vacuum aperture changing mechanism comprises one or more piezoelectric actuators, DC motors or stepper motors for driving stage.

12. (Currently Amended) An ion gun for a focused ion beam system, comprising:

a gun chamber dielectric housing being at least partially constructed of a dielectric material and defining a gun chamber;

an emitter assembly fastened to positioned within the gun chamber dielectric housing, the emitter assembly including an a pre-aligned liquid metal ion emitter, a suppressor, an extractor and an extractor aperture; and

one or more ion optical elements fastened to the gun chamber dielectric housing and aligned with the emitter assembly.

13. (Original) The ion gun of claim 12 in which the emitter assembly and the one or more optical elements are maintained in a vacuum and in which the dielectric housing provides the walls of a vacuum chamber.

14. (Original) The ion gun of claim 12 in which the dielectric housing is surrounded by a metallic shield.

15. (Original) The ion gun of claim 12 further comprising a vacuum isolation valve actuatable to seal the ion gun.

16. (Original) The ion gun of claim 12 in which the position of the emitter assembly can be adjusted to align the emitter assembly with the one or more ion optical elements fastened to the dielectric housing.

17. (Original) The ion gun of claim 12 in which the position of the emitter assembly is fixed in alignment relative to the one or more ion optical elements fastened to the dielectric housing.

18. (Currently Amended) A ion gun dielectric bushing comprising a dielectric material formed to support and align multiple ion optical elements and to form a vacuum chamber surrounding those elements, the vacuum chamber including at least one opening for supplying electrical voltage to one or more of the multiple optical elements and the vacuum chamber being isolatable from a separate system vacuum chamber.

19. (Currently Amended) A pre-aligned emitter assembly for a focused ion beam comprising an liquid metal ion emitter, a suppressor, an extractor and at least one extractor aperture element, the emitter, suppressor, and extractor being positioned and aligned with respect to each other, the assembly capable of being inserted as a unit into an ion beam optical column.

20. (Original) The emitter assembly of claim 19 further comprising a dielectric housing for supporting the emitter, suppressor, and extractor.

21. (Original) The emitter assembly of claim 20 in which the dielectric housing includes a hole for passing an electrical conductor.

22. (Original) A focused ion beam column including:

a prealigned emitter assembly in accordance with claim 19; and

a mating member for supporting and positioning the emitter assembly.

9)
Cont
23. (Currently amended) A method of forming a gun assembly for a focused ion beam column, comprising: providing a dielectric housing configured to support multiple gun elements and to form a sealable vacuum container for the gun; aligning metallic optical elements within the dielectric housing; and providing electrical connections to the metallic optical elements through the one or more dielectric housings.

24. (Currently Amended) The method of claim 21-23 further comprising providing a vacuum pump for evacuating the vacuum container formed by the dielectric housing.

25. (Currently Amended) The method of claim 21-23 further comprising providing a vacuum isolation valve for isolating the dielectric housing.

26. (Original) In a multiple beam system for producing a focused ion beam column and a second charged particle beam within a system vacuum chamber, the focused ion beam column including a liquid metal ion source, a plurality of lens elements for extracting and focusing the ions, one or more beam apertures, an electrostatic deflection means, beam blanking means, and vacuum pump plus associated electronics and controls, the improvement comprising an ion gun dielectric bushing for supporting

one or more gun elements and for providing a gun vacuum container for the one or more gun elements.

27. (Original) The method of claim 26 further comprising a vacuum isolation valve for isolating the gun vacuum container, the vacuum isolation valve actuation mechanism being operable without a mechanical drive connection to outside a system vacuum chamber.

28. (Original) The method of claim 27 in which the vacuum isolation valve is operated pneumatically and in which a pneumatic connection for operating the vacuum isolation valve passes through the wall of the system vacuum chamber.

91
cont
29. (Original) The method of claim 26 further comprising an automated variable aperture drive positioned within the vacuum chamber, the drive being operable without a mechanical drive connection to outside the vacuum chamber.

30. (Original) The method of claim 29 in which the automated variable aperture drive includes a piezoelectric positioner.

31. (Original) The method of claim 29 in which the automated variable aperture drive includes an electric motor.

92
32. (New) The FIB mechanism of claim 10 in which the in-vacuum aperture changing mechanism comprises a drive mechanism that is contained within the system vacuum chamber, thereby eliminating the requirement for a mechanical feedthrough to change the aperture.

33. (New) The FIB mechanism of claim 12 in which the emitter assembly is moveable in relation to the one or more ion optical elements.

34. (New) The FIB mechanism of claim 12 in which the emitter assembly is attached to the gun chamber housing and fixed in relation to the one or more ion optical elements.

35. (New) In a FIB column including a system vacuum chamber; an ion gun including a liquid metal ion source; a plurality of lens elements for extracting and focusing the ions, one or more beam apertures; and an electrostatic deflection means, the improvement comprising an in-vacuum for isolating the ion gun from the system vacuum chamber, the in-vacuum isolation valve having no mechanical linkage from the valve to the outside of the system vacuum chamber.

92
36. (New) The FIB of claim 35 in which the in-vacuum isolation valve includes a pneumatic bellows to controllably activate the valve.

Cont
37. (New) The FIB of claim 35 in which the in-vacuum isolation valve includes a pushrod and bell crank to activate the valve.
